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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/807,528	03/23/2004	Takayuki Yamagishi	ASMJP.146AUS	3438

20995 7590 04/01/2008
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EXAMINER	
DHINGRA, RAKESH KUMAR	

ART UNIT	PAPER NUMBER
1792	

NOTIFICATION DATE	DELIVERY MODE
04/01/2008	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No.	Applicant(s)	
	10/807,528	YAMAGISHI ET AL.	
	Examiner	Art Unit	
	RAKESH K. DHINGRA	1792	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE _03_ MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on _28 December 2007_.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) _1-30_ is/are pending in the application.

4a) Of the above claim(s) _18-27_ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) _1-17 and 28-30_ is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on _30 December 1999_ is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

Applicant's arguments filed 12/28/07 have been fully considered but they are not persuasive as explained hereunder.

Claims 1-30 are now pending out of which claims 1-17 and 28-30 are presently active.

1) Applicant has argued that the electrodes shown in Tomoyasu and Ito are capacitively coupled electrodes, not an inductance electrode, and there is no evidence that capacitively coupled electrodes were replaceable with an inductance electrode (the ladder-type electrode of Murata). On the contrary, Murata well recognizes the differences between the ladder-type electrode (an inductance electrode) and the parallel-plate type electrodes (capacitively coupled electrodes) and describes the problems separately. Murata then provides a solution only with regard to the ladder-type electrode, and Murata in no way teaches that his solution can apply to the parallel-plate type electrodes. Since the ladder-type electrode and the parallel-plate type electrodes work differently, combining the prior art elements is not sufficient to render the claimed invention obvious. Further, as explained below, there is no evidence that multiply branching branches connected to parallel-plate type electrodes and their functions were known.

Examiner responds that Tomoyasu teaches that due to problems of non-uniformity of electric field distribution, experienced while raising the frequency of high frequency power supply, his invention is aimed at decreasing the non-uniformity of electric field distribution on the surface of an electrode and thus making the density of plasma uniform, (col. 2, lines 20-25). Similarly Murata et al also teaches that it is difficult to increase the frequency of the high frequency power source 4 in the apparatus using a ladder type electrode resulting in non-uniform electric field and non-uniform plasma density (col. 3, lines 1-25). Thus it is apparent that both Tomoyasu and Murata's endeavours were aimed at improving the uniformity of electrical field distribution over the surface of the electrode to obtain a uniform plasma density distribution and it would be obvious to combine these for obtaining solution for obtaining uniform electric

field distribution on the electrode surface. Further, about applicant's argument that there is no evidence that capacitively coupled electrodes were replaceable with an inductance electrode (the ladder-type electrode of Murata) examiner responds that the claimed invention pertains to the high frequency power supply system for a common problem (that is non-uniform electric field distribution), rather than the type of electrode.

2) In response to applicant's argument that Tomoyasu does not teach that high frequency power is supplied at multiple positions at the same time or simultaneously, examiner states that claim 1 does not recite any such limitation.

3) applicant further contends that Murata teaches a ladder-type electrode having multiple supply points arranged at two opposing sides of the ladder-type electrode, i.e., an inductance electrode. An inductance electrode and capacitively coupled plate electrodes are technologically and structurally different and non-replaceable at least with regard to the RF power supply manner. As discussed earlier, Murata itself distinguishes the ladder-type electrode from parallel-plate type electrodes and applies the multiple supply point arrangement solely to the ladder-type electrode. There is no evidence that an inductance electrode and capacitively coupled plate electrodes were replaceable with regard to the RF power supply manner.

Examiner responds that as explained above, both Tomoyasu and Murata's endeavours were aimed at improving the uniformity of electrical field distribution over the surface of the electrode to obtain a uniform plasma distribution, and that the claimed invention pertains to the high frequency power supply system for a common problem (that is non-uniform electric field distribution), rather than the type of electrodes.

4) Applicant further argues that neither Tomoyasu nor Murata recognizes stray capacitance arising between the radio-frequency channels and their peripheral parts and/or individual characteristic-impedance differences caused by characteristic errors of the coaxial cables. Due to the configurations in

the parallel-plate type electrodes recited in claim 1, even if there is stray capacitance and/or individual characteristic-impedance differences, film thickness non-uniformity within +3%, which is required for recent LSI devices, can be achieved. The results would not have been predictable from Tomoyasu and Murata.

Examiner responds that applicant's argument pertaining to stray capacitance are not supported by claim 1 limitations.

5) regarding applicant's further argument that Ito does not teach multiply-branching branches and therefore the coils of Ito cannot be used "to render substantially equal the characteristic impedance value of each branch connected to the multiple supply points" as recited in claim 1 and that no prior art teaches a combination of multiply-branching branches and at least inductance adjuster installed at least in one branch.

Examiner responds that Tomoyasu et al already teaches claim limitation of multiple branches 69 branched off from the inlet transmission path 68 (Fig. 9). Further, Murata teaches claim limitation pertaining to the electrode 32 having multiple supply points 44-51 that are multiple branchings down stream of the inlet transmission path. Ito reference is used, since it teaches claim limitation pertaining to use of inductance adjuster removably installed (through switch 13) for impedance adjustment. It would be obvious to install at least one inductance adjuster removably installed in at least one branch as per teaching of Ito to obtain equal characteristic impedance in each branch connected to multiple supply points. Thus Tomoyasu in view of Murata and Ito teach all limitations of claim 1 and the rejection is maintained. Further, in view of comments given above regarding claim 1, rejection of balance claims 2-17 and 28-30 is also maintained.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1-6, 9, 10, 14-17, 28-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tomoyasu (US Patent No. 7,153,387) in view of Murata et al (US Patent No. 6,363,881) and Ito et al (US Patent No. 5,935,374).

Regarding Claims 1, 2, 4, 5, 15, 16, 30: Tomoyasu teaches a plasma apparatus comprising:

a reactor chamber 2;

a pair of parallel-plate electrodes 21, 5 disposed inside the chamber, between which a substrate W to be processed is disposed; and where the upper electrode 21 includes showerhead 23 with large number of gas discharge holes 24 (usually in thousands), and electrode 5 is a susceptor;

a radio-frequency power supply system (power supply 40 with matching unit 41 and switching elements 71 with a controller 72) used for transmitting radio-frequency power to the top electrode 21 via multiple supply points 60' provided on the top electrode 21,

said radio-frequency power supply system comprises:

a radio-frequency power source 40; and

a radio-frequency transmission unit for transmitting radio-frequency power from the radio-frequency power source to the multiple supply points 60' on the top electrode 21;

said radio-frequency transmission unit comprising:

a feeder rod 68 (inlet transmission path) and feeder members 69 (like multiple branches) branched off from the inlet transmission path (e.g. Fig. 9 and col. 12, lines 1-67).

Tomoyasu does not teach that each branch connected to the supply point of the parallel-electrode is multiple branchings downstream of the inlet transmission path and has a substantially equal characteristic impedance value; and that at least one inductance adjuster which is removably installed in at least one branch to render substantially equal the characteristic impedance value of each branch connected to the multiple supply points.

Murata et al teach a plasma treatment apparatus for thin-film deposition comprising:

a reactor chamber 31 with a electrode 32 having multiple supply points 44-51 that are multiple branchings (2x4 = 8) downstream of the inlet transmission path (from the high frequency power source 36 up to power distributor 60) for the purpose of providing power at multiple supply points. Murata et al also teach impedance converters (inductance adjusters) 61a-61h in each of the branches (including coaxial cables 43a – 43h) to achieve impedance matching among power distributor 60, coaxial cables 43a-h, and the electrode 32 (e.g. Figs. 1, 2, 4 and col. 7, line 54 to col. 8, line 40).

Therefore it would have been obvious to one of ordinary skills in the art at the time of the invention to use a radio frequency transmission path where each branch at the top electrode is multiple

branchings downstream of the inlet transmission path as taught by Murata et al in the apparatus of Tomoyasu to obtain uniform high frequency electric power supply distribution uniformly at multiple points on the top electrode and thus have uniform plasma density.

Tomoyasu in view of Murata et al do not explicitly teach each branch has a substantially equal characteristic impedance value, and the one inductance adjuster is removably installed in at least one branch to render substantially equal the characteristic impedance value of each branch connected to the multiple supply points.

Ito et al teach a plasma CVD apparatus 300 (Figure 7) comprising:

A reaction chamber 5, in which a high frequency power from power source 3 is applied to electrode 2 and whereby a plasma is generated between the electrode 2 and an opposite electrode 4 that supports a substrate 6 to be processed. Ito et al further teach an impedance adjusting device (for the purpose of adjusting the impedance of the gas introduction pipe 1 with respect to plasma chamber impedance) comprising a coil set 12 which includes a plurality of coils (three, as show in Fig. 7) connected in parallel and each coil having a switch 13 (inductance adjuster). Ito et al also teach that by turning the switch on/off of three coils of the coil set 12 (that is, removable inductance adjuster), inductance and therefore impedance of the gas introduction pipe can be adjusted relative to plasma load impedance (column 9, lines 29-62). It would be obvious to install at least one inductance adjuster removably installed in at least one branch as per teaching of Ito to obtain equal characteristic impedance in each branch connected to multiple supply points as a result of adjusting the inductance of the line (branch). In view of above and the teaching of Murata et al that impedance converters 61a-61h are provided in each branch, characteristic impedance of each line can be adjusted. Claim limitation regarding equal characteristic impedance in each branch is a process limitation and since

the apparatus provides impedance converters in each branch that enable adjustment of impedanc, the apparatus is considered capable of meeting the claim limitation.

Therefore it would have been obvious to one of ordinary skills in the art at the time of the invention to use at least one inductance adjuster which is removably installed in a branch of the power supply path as taught by Ito et al in the apparatus of Tomoyasu in view of Murata et al to enable adjust characteristic impedance of each branch with respect to plasma chamber impedance (including equalizing the characteristic impedance, as per process limitations).

Regarding Claim 3: Murata et al teach (Figure 2) that each branch 43a-h connected to the multiple supply points 44-51 is two branchings downstream (Figure 3) of the inlet transmission path, and four branches (43a-d and 43e-h) are connected to the multiple supply points 44-51 (Column 8, lines 5-25).

Regarding Claim 6: Murata et al teach that impedance converter (inductance adjuster) 61a-h comprises of ferrite core (Figure 7 and column 8, lines 30-40).

Regarding Claim 9: Murata et al teach that power distributor 60 has a frequency of 30 MHz to 200 MHz (about 27.12 MHz or higher) {Column 5, lines 55-60}.

Regarding Claim 10: Tomoyasu teaches supply terminal points 60' are disposed in rotational symmetry about the center of surface of top electrode 21 (Figure 9 and column 12, lines 15-25).

Regarding Claims 14, 17: Murata et al teach cable 59 (Figure 2) connected between impedance matching network 35 and power distributor 60 but do not explicitly disclose it to be coaxial cable. But since Murata et al teach all other cables 41a-h, 43a-h to be coaxial cables, cable 59 would also be a coaxial cable due to high frequency power applications (Column 7, lines 55-68).

Regarding Claims 28, 29: Murata et al teach that supply terminal 44-51 are disposed in the vicinity of outer periphery of electrode 32 at regular intervals (Figure 2).

Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Tomoyasu (US Patent No. 7,153,387) in view of Murata et al (US Patent No. 6,363,881) and Ito et al (US Patent No. 5,935,374) as applied to claim 1 and further in view of Blonigan et al (US PGPUB No. 2002/0046989).

Regarding Claim 7: Tomoyasu et al in view of Murata et al and Ito et al teach al limitations of the claim including that impedance converters (inductors) 61a-h enable to achieve impedance matching between power distributor 60, coaxial cables 43a-h and electrode 32 (substantially equal impedance {includes inductive reactance} values in branches) [Murata et al, Figure 2 and Column 8, lines 25-40].

Tomoyasu et al in view of Murata et al and Ito et al do not teach radio frequency power transmission unit comprises a metal plate.

Blonigan et al teach a plasma apparatus (Figures 1-3) that comprises a power supply system 50 which includes a matching network 400 having an inductor 240 and capacitors 203-217 connected via conductive straps 402a-402h to multiple points on showerhead (electrode) 122, through a backing (metal) plate 126 for the purpose of providing electrical connection between the outputs from the matching network and the upper electrode 122 (Paragraphs 0022, 0025-0026).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to provide a metal plate in the radio frequency power transmission unit as taught by Blonigan et al in the apparatus of Tomoyasu et al in view of Murata et al and Ito et al to provide electrical connection between the output from matching network and the upper electrode

Claim 8 is rejected under 35 U.S.C. 102(b) as being unpatentable over Tomoyasu (US Patent No. 7,153,387) in view of Murata et al (US Patent No. 6,363,881) and Ito et al (US Patent No. 5,935,374) as applied to claims 1, 6 and further in view of MacGaffigan (US Patent No. 5,182,427).

Regarding Claims 8: Tomoyasu in view of Murata et al and Ito et al teach all limitations of the claim (as explained above under claim 1) including the transmission unit comprising a metal plate 126 and that impedance converters (inductors) 61a-h comprise ferrite core of circular ring shape (Murata et al, Figure 7) that enable to achieve impedance matching between power distributor 60, coaxial cables 43a-h and electrode 32 (substantially equal impedance values in branches).

Tomoyasu in view of Murata et al and Ito et al do not teach each inductor comprising a hollow copper tube and the ferrite core can be inserted/attached into the hollow copper tube to adjust an impedance value of the transmission system by selecting the number of ferrite cores to be inserted/attached.

MacGaffigan teach an apparatus (Figures 1-5) comprising a ferrite copper tube 22 in which ferrite beads 16 (ferrite cores) can be inserted and the number of beads16 (cores) can be controlled for the purpose of controlling the impedance of the apparatus (impedance adjuster). Further, it would be obvious to use the arrangement of copper tube with ferrite cores could be used in multiple branches to enable control impedance on an incremental basis in multiple branches (column 16, line 40 to column 17, line 25).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use inductance adjuster comprising of hollow copper tube with ferrite cores whose number can be selected as taught by MacGaffign in the apparatus of Tomoyasu in view of Murata et al and Ito et al to enable obtain easy and incremental impedance adjustment with high frequency power sources in multiple branches (column 5, lines 14-45).

Claim 11 is rejected under 35 U.S.C. 102(b) as being unpatentable over Tomoyasu (US Patent No. 7,153,387) in view of Murata et al (US Patent No. 6,363,881), Ito et al (US Patent No.

5,935,374) and Blonigan et al (US PGPUB No. 2002/0046989) as applied to claim 7 and further in view of MacGaffigan (US Patent No. 5,182,427).

Regarding Claim 11: Tomoyasu in view of Murata et al, Ito et al and Blonigan et al teach all limitations of the claim (as explained above under claim 1) including the transmission unit comprising a metal plate 126 and that impedance converters (inductors) 61a-h comprise ferrite core of circular ring shape (Murata et al, Figure 7) that enable to achieve impedance matching between power distributor 60, coaxial cables 43a-h and electrode 32 (substantially equal impedance values in branches).

Tomoyasu in view of Murata et al, Ito et al and Blonigan et al do not teach each inductor comprising a hollow copper tube and the ferrite core can be inserted/attached into the hollow copper tube to adjust an impedance value of the transmission system by selecting the number of ferrite cores to be inserted/attached.

MacGaffigan teach an apparatus (Figures 1-5) comprising a ferrite copper tube 22 in which ferrite beads 16 (ferrite cores) can be inserted and the number of beads16 (cores) can be controlled for the purpose of controlling the impedance of the apparatus (impedance adjuster). Further, it would be obvious to use the arrangement of copper tube with ferrite cores could be used in multiple branches to enable control impedance on an incremental basis in multiple branches (column 16, line 40 to column 17, line 25).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use inductance adjuster comprising of hollow copper tube with ferrite cores whose number can be selected as taught by MacGaffign in the apparatus of Tomoyasu in view of Murata et al, Ito et al and Blonigan et al to enable obtain easy and incremental impedance adjustment with high frequency power sources in multiple branches (column 5, lines 14-45).

Claims 12, 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tomoyasu (US Patent No. 7,153,387) in view of Murata et al (US Patent No. 6,363,881) and Ito et al (US Patent No. 5,935,374) as applied to Claim 1 and further in view of DeOrnellas et al (US Patent No. 6,190,496).

Regarding Claims 12,13: Tomoyasu in view of Murata et al and Ito et al teach all limitations of the claim except second radio frequency power source.

DeOrnellas et al teach an apparatus (Figure 1) that includes a reactor chamber 22, an upper electrode grounded electrode 24 and a bottom electrode 28 that is connected to a first high frequency power supply 30 and also a second power supply 32 which is operated at 450KHz and enables control the ion energy (Column 2, line 65 to Column 3, line 30).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use second power source connected to plasma electrode as taught by DeOrnellas et al in the apparatus of Tomoyasu in view of Murata et al and Ito et al to enable control ion energy control (Column 3, lines 30-40).

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to RAKESH K. DHINGRA whose telephone number is (571)272-5959. The examiner can normally be reached on 8:30 -6:00 (Monday - Friday).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Parviz Hassanzadeh can be reached on (571)-272-1435. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/Rakesh K Dhingra/
Examiner, Art Unit 1792

/Karla Moore/
Primary Examiner, Art Unit 1792